

# Expedition Report: EX-21-07 Windows to the Deep 2021 (ROV and Mapping)

Blake Plateau, Portales Terrace, and the West Florida Shelf  
Charleston, South Carolina, to Port Canaveral, Florida  
October 26-November 15, 2021

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# Abstract

The Windows to the Deep 2021: Southeast U.S. ROV and Mapping expedition (EX-21-07) was a combined mapping and remotely operated vehicle (ROV) expedition to the Blake Plateau and Florida Straits that took place between October 26, 2021, and November 15, 2021. Operations during the 21-days at sea featured ROV dives in support of NOAA Ocean Exploration and its partners' priorities, including exploring the southern and eastern portions of the Stetson-Miami Habitat Area of Particular Concern and the Blake Plateau's water column. The primary focus of this expedition was the Blake Plateau, including the Blake Escarpment and Blake Spur, off the coast of the Southeast United States. Due to unfavorable weather conditions on the Blake Plateau, three ROV dives were conducted in the western and central Florida Straits. Overall, 14 dives were completed, totaling 47 hours of bottom time and exploring depths from 300 to 3,650 m. These dives included two dedicated water column dives, several dives on mound and ridge-like bioherm structures, two deeper than 3300 m dives on the steep Blake Escarpment, and one dive on a lone sinkhole in the southeast region of the Blake Plateau. During mapping operations, 15,800 square km of seafloor were mapped using the ship's EM 304 multibeam sonar system. All data associated with this expedition have been archived and are publicly available through the NOAA archives.

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# 1. Introduction

NOAA Ocean Exploration is the only federal program dedicated to exploring the deep ocean, closing prominent gaps in our basic understanding of U.S. deep waters and the seafloor. These activities deliver the ocean information needed to strengthen the economy, health, and security of our nation.

Using the latest tools and technology, NOAA Ocean Exploration explores previously unknown areas of our deep ocean, making discoveries of scientific, economic, and cultural value. Through live video streams, online coverage, training opportunities, and real-time events, NOAA Ocean Exploration allows scientists, resource managers, students, members of the general public, and others to actively experience ocean exploration, expanding available expertise, cultivating the next generation of ocean explorers, and engaging the public in exploration activities. To better understand our ocean, NOAA Ocean Exploration makes its exploration data available to the public. This allows us, collectively, to more effectively maintain ocean health, sustainably manage our marine resources, accelerate our national economy, and build a better appreciation of the value and importance of the ocean in our everyday lives.

## 1.1 Atlantic Seafloor Partnership for Integrated Research and Exploration

Data collected during expeditions on NOAA Ship *Okeanos Explorer* from 2018-2022 directly contribute to the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE), a major multiyear, multinational collaborative field program focused on raising collective knowledge and understanding of the North Atlantic Ocean. ASPIRE builds on the momentum of past U.S. campaigns and international initiatives to support ecosystem-based management of marine resources. ASPIRE also provides information relevant to NOAA's emerging Blue Economy priorities, which, in addition to ocean exploration, are seafood production, tourism and recreation, marine transportation, and coastal resilience.

## 2. Expedition Overview

From October 26 to November 15, 2021, NOAA Ocean Exploration and partners conducted a telepresence-enabled ocean exploration expedition on *Okeanos Explorer* to collect critical baseline information and improve knowledge about unexplored and poorly understood deepwater areas of the Blake Plateau, Blake Spur, Portales Terrace, and West Florida Escarpment. EX-21-07 was designed to contribute to ASPIRE by providing timely, actionable information to support decision-making based on reliable and authoritative science and leveraging the work of other NOAA Ocean Exploration work in the region, including expeditions

on *Okeanos Explorer* (EX-18-05, EX-18-06, EX-19-03-L1, EX-19-03-L2, EX-19-06, EX-19-07, EX-21-01, EX-21-02, EX-21-05, EX-21-06) and survey work contracted to Fugro (KR-OER-19-01). Like other ASPIRE expeditions, it also served as an opportunity for NOAA to highlight the uniqueness and importance of deepwater environments.

## 2.1 Rationale for Exploration

Prior to ASPIRE, the southeastern U.S. continental margin had some of the largest gaps in high-resolution ocean mapping data on the East Coast, and observations acquired by remotely operated vehicles (ROVs) were limited. During two previous expeditions in 2021 (EX-21-05 and EX-21-06), many of the bathymetric gaps on the Blake Plateau were mapped. These new mapping data included much of the Stetson-Miami Terrace Deepwater Coral Habitat Area of Particular Concern, giving scientists new insight into the abundance of mounding and scarp features that were revealed and setting the stage for follow-on ROV exploration.

As part of the planning for this expedition, NOAA Ocean Exploration collaborated with the scientific and management community to assess the exploration needs and data gaps in unknown and poorly known areas of the Blake Plateau. To define the operating area for this expedition, the office considered the 2018 call for input, results from the 2018 ASPIRE Workshop (NOAA, n.d.a), and priorities identified by resource managers.

Data and information from this expedition will help improve our understanding of the deep-ocean habitats of the U.S. continental margin and the connections between communities throughout the Atlantic basin. It will also inform deep-sea management plans for habitat areas of particular concern (HAPCs), marine protected areas (MPAs), and national marine sanctuaries; support local scientists and managers seeking to understand and manage deep-sea resources; and stimulate subsequent exploration, research, and management activities.

This expedition also contributed to the ongoing collaboration with the NOAA Office of National Marine Sanctuaries Maritime Heritage Program, the Bureau of Ocean Energy Management (BOEM), the U.S. Geological Survey (USGS), NOAA Fisheries' Deep Sea Coral Research and Technology Program (DSCRTP), and the Smithsonian National Museum of Natural History (NMNH).

## 2.2 Objectives

The expedition addressed scientific themes and priority areas put forward by NOAA scientists and resource managers, the South Atlantic Fishery Management Council (SAFMC), BOEM, USGS, and the broad ocean science community. The primary objective of the expedition was to

survey deepwater areas offshore of South Carolina, Georgia, and Florida to provide baseline information to support science and management needs. Specifically, this expedition sought to:

- Acquire data on deepwater habitats on the Blake Plateau to support priority science and management needs.
- Identify, map, and explore the diversity and distribution of benthic habitats, including fish habitats, deep-sea coral and sponge communities, midwater communities, and biological communities that colonize or aggregate around shipwrecks.
- Explore U.S. maritime heritage by identifying and investigating sonar anomalies as well as characterizing shipwrecks.
- Investigate biogeographic patterns of deep-sea ecosystems and connectivity across the Blake Plateau for use in broader comparisons of deepwater habitats throughout the Atlantic basin.
- Map, survey, and sample geological features within the southeastern U.S. continental margin to better understand the geological context of the region and improve knowledge of past and potential future geohazards.
- Collect high-resolution bathymetry in areas with no or low-quality mapping data.
- Acquire a foundation of remotely operated vehicle, sonar, and oceanographic data to better understand the characteristics of the water column and fauna that live there.
- Engage a broad spectrum of the scientific community and the public in telepresence-based exploration.
- Pilot operational eDNA sampling using the five Niskin bottles on the ROV *Deep Discoverer*.
- Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

### 3. Participants

EX-21-07 included onboard mission personnel as well as shore-based science personnel who participated remotely via telepresence. See **Table 1** for the onboard personnel who supported EX-21-07. **Appendix A** contains the shore-based personnel.

**Table 1.** EX-21-07 onboard mission team personnel

Name	Title	Affiliation
Dornback, Matt	Expedition Coordinator	NOAA Ocean Exploration (CNSP <sup>1</sup> )
Sowers, Derek	Mapping Lead	NOAA Ocean Exploration (CNSP <sup>1</sup> )
Candio, Sam	Mapping Lead	NOAA Ocean Exploration (CNSP <sup>1</sup> )
Gillespie, Trey	Mapping Watch Lead	University Corporation for Atmospheric Research
Farrington, Stephanie	Science Lead	University Corporation for Atmospheric Research
Collins, Allen	Science Lead	NOAA National Marine Fisheries Service
Ritter, Chris	ROV Lead	Global Foundation for Ocean Exploration
O'Brien, Andy	Data Engineer	Global Foundation for Ocean Exploration
Aragon, Fernando	Data Engineer	Global Foundation for Ocean Exploration
Wright, Chris	Data Engineer	Global Foundation for Ocean Exploration
Meyers, Jim	Data Engineer	Global Foundation for Ocean Exploration
Unema, Levi	ROV Engineer	Global Foundation for Ocean Exploration
Laning, Jeff	ROV Engineer	Global Foundation for Ocean Exploration
Kennison, Sean	ROV Engineer	Global Foundation for Ocean Exploration
Murphy, Lars	ROV Engineer	Global Foundation for Ocean Exploration
Howard, Art	Videographer	Global Foundation for Ocean Exploration
Bailey, Caitlin	Videographer	Global Foundation for Ocean Exploration
Narrow, Emily	Videographer	Global Foundation for Ocean Exploration
Brian, Roland	Videographer	Global Foundation for Ocean Exploration

<sup>1</sup> Cherokee Nation Strategic Programs

## 4. Methodology

To accomplish its objectives, EX-21-07 used:

- NOAA Ocean Exploration’s dual-bodied ROV system (ROVs *Deep Discoverer* and *Seirios*) to conduct daytime seafloor and water column surveys as well as to collect a limited number of samples, including water samples for environmental DNA (eDNA) processing, to help further characterize the deepwater fauna and geology of the region.

- Sonar systems (Kongsberg EM 304 multibeam sonar, Knudsen 3260 sub-bottom profiler, Simrad EK60 and EK80 split-beam sonars, and Teledyne acoustic Doppler current profilers) to conduct mapping operations at night and when the ROVs were on deck.
- A high-bandwidth satellite connection to provide real-time ship-to-shore communications (telepresence).

All environmental data collected by NOAA must be covered by a data management plan to ensure they are archived and publicly accessible. The data management plan for EX-21-07 is in “Project Instructions: EX-21-07, Windows to the Deep 2021: Southeast U.S. (ROV and Mapping)” (Dornback, 2021).

## 4.1 ROV Seafloor Surveys

ROV dive operations supported the expedition objectives in Section 2.2 and included high-resolution visual surveys of seafloor and water column habitats as well as geological and biological sampling. During each dive, the ROVs descended to the seafloor and then moved from waypoint to waypoint, documenting the geology and biology of the area. Each ROV dive was approximately eight hours, conditions and logistics permitting. Dives were conducted during the day (operations are described in detail by Quattrini et al., 2015 and Kennedy et al., 2019). Additional information about the general process of site selection, collaborative dive planning, scientific equipment on the ROVs, and the approach to benthic exploration used on *Okeanos Explorer* can be found in Kennedy et al. (2019).

Onboard and shore-based scientists identified each encountered organism to the lowest taxon possible based on data available during real-time assessment. Additionally, they provided geological interpretations of the observed substrate throughout each ROV seafloor survey. These geological and biological observations were recorded using Ocean Networks Canada’s SeaTube. These data are quality controlled and quality assured at the University of Louisiana at Lafayette by ASPIRE science advisor Scott France and his laboratory.

For water column exploration, a series of transects were performed during vehicle descent followed by a short exploration of the seafloor. Transects primarily targeted the deep scattering layer and the waters directly above and below it. Specific transect depths were decided each day during ROV descent through an evaluation of the Simrad EK60 and EK80 data; ROV conductivity, temperature, depth (CTD) data; and the acoustically determined position of the deep scattering layer. For the first midwater dive (Dive 03, Midwater North), a standard set of transects at 300, 500, 600, 700, and 10 m off bottom were used. The length of time of the transects was 40 minutes at each depth, except for the 25 m off bottom transect, which was only for 30 minutes due to limited dive time remaining. During the second midwater dive (Dive

13, Midwater South), the ROVs had to be recovered early, so it consisted of just two 65 minute transects at 300 and 500 m (the deep scattering layer coincided with this standard depth).

## 4.2 Sampling Operations

A limited number of geological and biological samples were collected on the seafloor using ROV *Deep Discoverer's* five-chamber suction sampler and two manipulator arms in conjunction with geological and biological collection boxes. The primary goal of the sampling operations was to collect voucher samples to be made publicly available for site characterization.

For each sample collected, the date, time, latitude, longitude, depth, salinity, temperature, and dissolved oxygen content were recorded at the time of collection. Geological samples were acquired for researchers to perform age dating and geochemical composition analysis. Biological collections targeted samples that represented potential new species, range extensions of animals not previously known to occur in the region, dominant species at the site, and/or rare morphotypes. Samples targeted to contribute to transatlantic connectivity studies were also collected.

After vehicle recovery, samples were examined for associated organisms, labeled, photographed, and entered into a database with all relevant metadata. Any associated organisms found were separated from primary samples and processed separately as “associate” samples.

Geological samples were air dried and placed in rock bags or small containers depending on the size of the sample. These samples were shipped to the Marine and Geological Repository at Oregon State University after the conclusion of the expedition. The samples will be photographed, and their data will be entered into the university's online database. Thin and polished sections will be made for each hard-rock sample. Descriptions and photos are included in the database.

Biological samples were subsampled for inclusion in the Smithsonian's National Museum of Natural History Biorepository for future DNA extraction and barcoding. For this purpose, a small subsample, consisting of not more than 1 cm<sup>2</sup> of tissue, was removed from the original sample and placed in 95% analytical grade ethanol (EtOH).

For most of the biological samples, the remainder of the sample was also preserved in 95% ethanol. For select taxa, vouchers or subsamples were preserved in 10%, 5%, or 4% buffered formalin per recommendation from taxonomic experts and guidance provided by the Smithsonian's National Museum of Natural History. Full details of the preservation of each biological sample are in the associated metadata record. All voucher samples and subsamples

were shipped to the Smithsonian’s National Museum of Natural History for long-term archiving and public access.

During this expedition, as many as five 1.7 liter water samples per dive were collected in Niskin bottles for eDNA processing. For benthic dives, water samples were taken at 500 m during descent; at the start, approximate middle, and end of the benthic transect; and at one other time at the discretion of the science leads. For midwater dives, water samples were taken at the start of each transect. Full details about the timing and data associated with each water sample are in the metadata record. Water sample filtration and filter preservation were conducted on the ship. For each set of samples, a tap water negative control was processed at the same time. All filters with DNA were shipped to the Smithsonian’s National Museum of Natural History for further processing, long-term archiving, and public access.

## 4.3 Acoustic Operations

Acoustic operations included Kongsberg EM 304 multibeam, Simrad EK60 and EK80 split-beam, Knudsen sub-bottom profiler, and acoustic Doppler current profiler (ADCP) data collection (Candio et al., 2021). The schedule of mapping operations included overnight transits and whenever the ROVs were on deck. Track lines were planned to maximize edge matching of existing data or filling of data gaps in areas with incomplete bathymetry coverage. In regions with no existing data, exploration transit lines were planned to optimize potential discoveries. Targeted mapping operations were conducted to fill in remaining gaps in multibeam sonar data coverage in the Blake Plateau region, improve mapping data coverage on and around the Blake Spur, and edge match multibeam mapping coverage in the Florida Straits.

### 4.3.1 Multibeam Sonar

Multibeam seafloor mapping data were collected using the Kongsberg EM 304 sonar, which operates at a nominal frequency of 26 kHz. Multibeam mapping operations were conducted during all overnight transits between ROV dive sites. Multibeam data quality was monitored in real time by acquisition watchstanders. Ship speed was adjusted to maintain data quality as necessary.

Whenever possible, transits were designed to maximize coverage over seafloor areas with no previous high-resolution mapping data. In these focus areas, line spacing was generally planned to ensure 30% overlap between lines at all times. Cutoff angles in the Seafloor Information System (SIS) software were generally adjusted on both the port and starboard sides to ensure the best balance between data quality and coverage. Overnight surveys were also completed in areas that were previously mapped with a lower resolution multibeam sonar system.

Additionally, multibeam mapping operations were conducted directly over planned ROV dive sites to collect seafloor mapping data to help refine dive plans. These operations collected data on seafloor depth (bathymetry), seafloor acoustic reflectivity (seafloor backscatter), and water column reflectivity (water column backscatter). Data on the Blake Spur Escarpment was enhanced by performing strategic low-speed mapping lines to provide better sounding density on the very steep wall of the feature.

Sources of background data used to guide exploratory multibeam mapping operations included NOAA Ocean Exploration expeditions EX-14-03, EX-18-05, EX-18-06, EX-19-03-L1, EX-19-03-L2, EX-19-06, KR-OER-19-01 (Fugro), EX-19-07, EX-21-01, EX-21-02, EX-21-05, and EX-21-06.

### 4.3.2 Sub-Bottom Profiler

The primary purpose of the Knudsen Chirp 3260 (3.5 kHz) sonar is to image sediment layers underneath the seafloor to a maximum depth of about 80 m below the seafloor, depending on the specific sound velocity of the substrate. The sub-bottom profiler was operated simultaneously with the multibeam sonar during mapping operations to provide supplemental information about the sedimentary features underlying the seafloor. Targeted sub-bottom sonar data files were collected in shallower water depths than typical for NOAA Ocean Exploration as test data files for the University of New Hampshire Center for Coastal and Ocean Mapping. These files were in water depths of approximately 50 m as the ship transited across the continental shelf toward Port Canaveral, Florida.

### 4.3.3 Split-Beam Sonars

*Okeanos Explorer* is equipped with five split-beam transducers, three Simrad EK60 general purpose transceivers and two Simrad EK80 wideband transceivers. The frequencies of the EK60 are 18, 38, 120, and 200 kHz. The frequency of the EK80 is 70 kHz.

These sonars were used nearly continuously throughout EX-21-07 during both overnight mapping operations and daytime ROV operations. The sonars provided calibrated target strength measurements (Copeland et al., 2021) of water column features such as dense biological layers and schools of fish. EK60 and EK80 data were also used during midwater transects of ROV dives to detect the depth of the deep scattering layers, which are aggregations of biological organisms in the water column.

### 4.3.4 Acoustic Doppler Current Profilers

*Okeanos Explorer* is equipped with two ADCPs: a Teledyne Workhorse Mariner (300 kHz) and a Teledyne Ocean Surveyor (38 kHz). The ADCPs provide information on the speed and direction of currents underneath the ship. They were used throughout ROV dives to support safe

deployment and recovery of the vehicles. The ADCPs were not used during multibeam mapping due to sonar interference with the EM 304.

### 4.3.5 Expendable Bathythermograph Systems

Expendable bathythermographs (XBTs) were generally deployed every two to three hours to generate water column sound velocity profiles that were applied in real time to multibeam sonar data collection using SIS. Sound speed at the sonar head was measured with a Reson sound velocity probe and quality checked with sound speed values derived from a flow-through thermosalinograph (TSG) with a water intake located near the multibeam transducers.

## 4.4 Conductivity, Temperature, and Depth

Conductivity, temperature, and depth (CTD) measurements were collected by two different methods. The most frequent method used was an integrated ROV CTD system. This system records data from the CTD and associated sensors on every dive. The second method used a dedicated CTD lowered with a winch to provide better information on the critical properties of the water column. Additional sensors installed on both CTDs measured light scattering (LSS), dissolved oxygen (DO), and oxygen-reduction potential (ORP).

## 4.5 Sun Photometer Measurements

NOAA Ocean Exploration gathers limited at-sea measurements aboard *Okeanos Explorer* to support a NASA-led, long-term research effort that assesses marine aerosols. As time allowed on cloud-free days, onboard personnel collected georeferenced sun photometer measurements for the Maritime Aerosol Network (MAN) component of the Aerosol Robotic Network (AERONET). AERONET is a network of sun photometers that measure atmospheric aerosol properties around the world. MAN complements AERONET by conducting sun photometer measurements on ships of opportunity to monitor aerosol properties over the global ocean.

# 5. Clearances and Permits

## 5.1 Environmental Clearances and Permits

Pursuant to the National Environmental Policy Act (NEPA), NOAA Ocean Exploration is required to include in its planning and decision-making processes appropriate and careful consideration of the potential environmental consequences of actions it proposes to fund, authorize, and/or conduct. The companion manual for NOAA Administrative Order 216-6A describes the agency's specific procedures for NEPA compliance.

An environmental review memorandum was completed for all *Okeanos Explorer* expeditions in 2021 in accordance with Section 4 of the companion manual in the form of a categorical exclusion worksheet (Dornback, 2021). Based on this review, a categorical exclusion was determined to be the appropriate level of NEPA analysis necessary, as no extraordinary circumstances existed that required the preparation of an environmental assessment or environmental impact statement. NOAA Ocean Exploration is preparing a programmatic environmental assessment to cover future expeditions.

NOAA Ocean Exploration conducted an analysis on the potential impacts to marine mammal species as a result of *Okeanos Explorer*'s oceanographic research and seafloor mapping under the Marine Mammal Protection Act (MMPA). It was determined that, due to the high-frequencies, narrow beamwidths, relatively low source-levels of the onboard sonars, and transient nature of the expeditions, it is unlikely that activities aboard *Okeanos Explorer* would meet the definition of harassment under the MMPA.

As required under Section 7 of the Endangered Species Act (ESA), NOAA Ocean Exploration conducted an informal consultation with NOAA Fisheries' Office of Protected Resources to request their concurrence with NOAA Ocean Exploration's biological evaluation determining that *Okeanos Explorer* operations conducted as part of ASPIRE may affect, but are not likely to adversely affect, ESA-listed marine species. In a letter dated February 3, 2021 (Wang, 2021), the chief of the ESA Interagency Cooperation Division in the Office of Protected Resources wrote that NOAA Fisheries concurs with NOAA Ocean Exploration's determination that proposed ASPIRE expeditions are not likely to adversely affect ESA-listed marine species.

A Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit and port exemption for EX-21-07 were obtained to cover the collection of antipatharian and scleractinian corals while operating in the high seas (**Appendix B**).

In addition, NOAA Ocean Exploration consulted with the NOAA Fisheries Southeastern Regional Office (SERO) on potential impacts of operations to essential fish habitat (EFH) in the U.S. Southeast region under the Magnuson-Stevens Fishery Conservation and Management Act. NOAA Ocean Exploration received a letter of acknowledgement from SERO on August 25, 2021, that covered expedition activities from August 25, 2021, through December 31, 2021 (Dornback, 2021).

## 5.2 Maritime Heritage Clearances and Permits

Maritime heritage activities conducted during expeditions on *Okeanos Explorer* are informed by the federal archaeology program, U.S. legislation on the treatment of cultural remains, and the UNESCO Convention for the Protection of the Underwater Cultural Heritage. NOAA Ocean

Exploration supports the standards for conducting marine archaeological activities enumerated in the rules in the annex of the UNESCO Convention on the Protection of the Underwater Cultural Heritage.

Preservation and protection of prehistoric and historic maritime heritage resources is the policy of the federal government, and NOAA Ocean Exploration has a responsibility to consider the effects of its activities on these resources. If data are found to be sensitive because they reveal the location of a historically significant cultural resource, Section 304 of the National Historic Preservation Act (NHPA) provides that the head of a federal agency or other public official shall withhold from public disclosure information about the location, character, or ownership of a historic property when disclosure may cause a significant invasion of privacy, risk harm to the historic property, or impede the use of a traditional religious site by Indigenous peoples. This document uses the term maritime heritage to refer to historic and prehistoric traces of human existence that are totally or partially underwater. Further information on NOAA Ocean Exploration maritime heritage policies are in the “NOAA Ship *Okeanos Explorer* FY22 Field Season Instructions” (Wang, 2021).

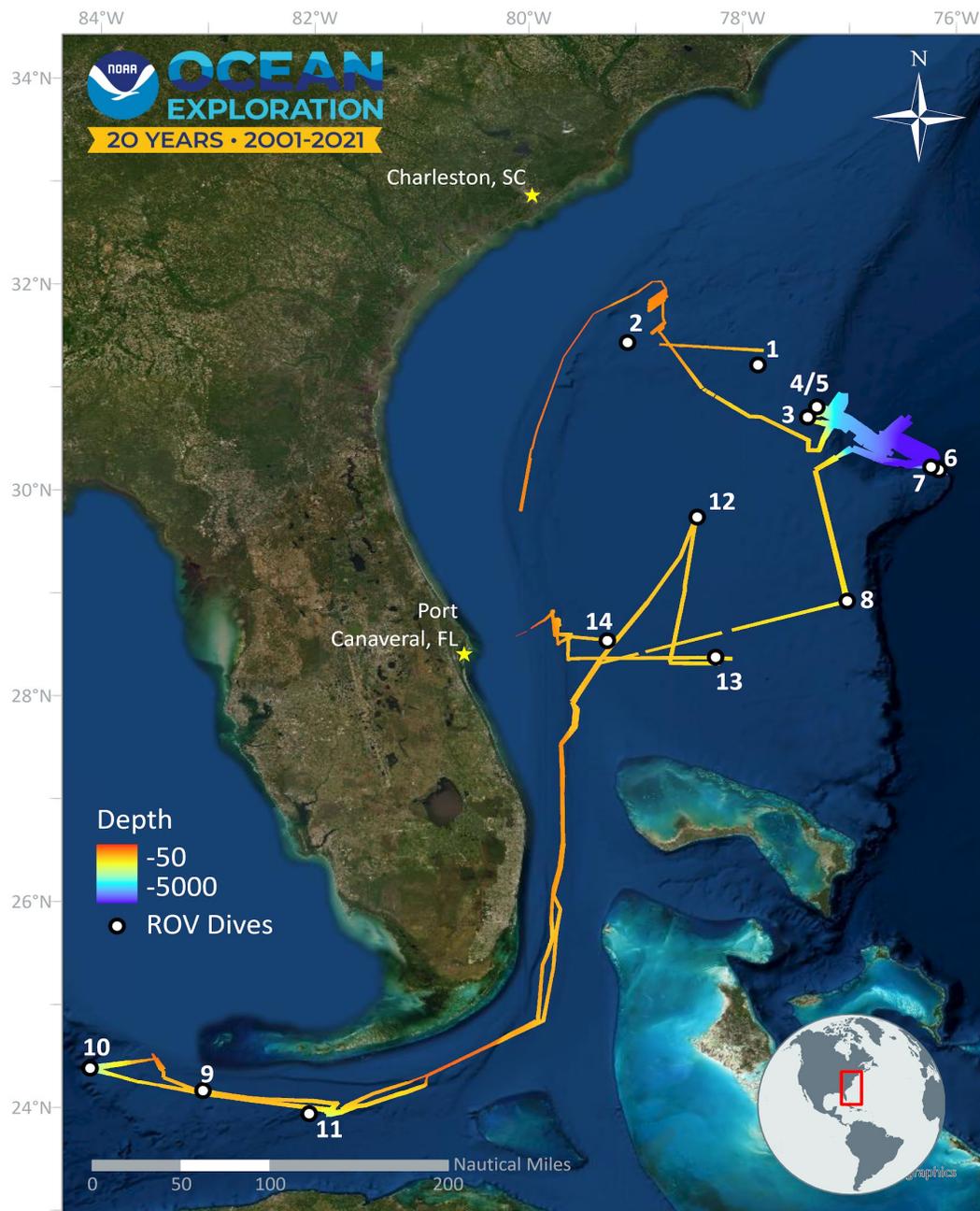
## 6. Schedule and Map

EX-21-07 was a total of 21 days at sea, from October 26, 2021, to November 15, 2021. It departed from Charleston, South Carolina, and returned to port in Cape Canaveral, Florida. See **Table 2** for a day by day breakdown of EX-21-07. There were 19 scheduled dives, with 14 dives achieved (see **Tables 5 and 6** for details). Unfavorable weather conditions on the Blake Plateau prevented dives October 29-31 and November 6 and 7. Due to a major weather system affecting the entire U.S. Atlantic seaboard, the ship relocated to the Florida Straits for Dives 09-11 (November 8-10). November 6 and 7 were spent transiting to the Florida Straits, and November 11 was spent transiting back to the Blake Plateau. ROV mechanical issues forced the early retrieval of the ROVs on Dives 04 and 13. See **Figure 1** for a map of EX-21-07's track, dive sites, and bathymetry collected.

**Table 2. EX-21-07 schedule**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
10/24	10/25 Mobilization: Charleston, South Carolina	10/26 Departure from Charleston  Overnight mapping operations	10/27 Dive 01 Reef Tracts  ACDP calibration  Overnight mapping operations	10/28 Dive 02 UCH Bloody Marsh  CTD cast and EM304 Patch Test  Overnight mapping operations	10/29 Dive canceled due to weather  24 hour mapping operations	10/30 Dive canceled due to weather  24 hour mapping operations
10/31 Dive canceled due to weather  24 hour mapping operations	11/1 Dive 03 Midwater North  Overnight mapping operations	11/2 Dive 04 Deep Mound  Dive 05, Deep Mound 2  Overnight mapping operations	11/3 Dive 06 Blake Spur Wall  Overnight mapping operations  EC Dornback Fox News Weather interview*	11/4 Dive 07 Blake Spur Canyon  Overnight mapping operations  Whitehouse OSTP interaction*	11/5 Dive 08 Sinkhole  Overnight mapping operations	11/6 Transit to Florida Strait  24 hour transit mapping operations
11/7 Transit to Florida Strait  24 hour transit mapping operations	11/8 Dive 09 Tortugas Scarp  Overnight mapping operations	11/9 Dive 10 Shark Fin  Overnight mapping operations	11/10 Dive 11 Key West Scarp  Overnight mapping operations	11/11 Transit to Blake Plateau  24 hour transit mapping operation	11/12 Dive 12 Knolls North  Overnight mapping operations  St. Raymond Academy interaction*	11/13 Dive 13 Midwater South  Overnight mapping operations
11/14 Dive 14 Million Mounds  Overnight mapping operations	11/15 Arrival in Port Canaveral, Florida  EC Dornback Weather Channel interview*	11/16 Demob:  Sample packing and shipping  ROVs craned off of ship	11/17 Mission team departure	11/18	11/19	11/20

\* Nonoperational media, outreach, and education events



**Figure 1.** Map showing EX-21-07's track, 14 ROV dive sites, and bathymetry data collected.

## 7. Results

Metrics for EX-21-07's major exploration and scientific work are summarized in **Tables 3 and 4**. More detailed results are presented in the subsections that follow.

**Table 3.** Summary of exploration metrics for EX-21-07

Exploration Metrics	Totals
Days at sea	21
Days at sea in U.S. waters	19
Linear km mapped by EM 304	2,001
Square km covered by EM 304	15,800
Square km covered by EM 304 in U.S. waters	13,600
Vessel CTD casts	1
XBT casts	127
ROV dives	14
ROV dives in U.S. waters	12
Maximum ROV seafloor depth (m)	3,650
Minimum ROV seafloor depth (m)	475
Total time on bottom (hh:mm:ss)	47:11:08
Water column survey time (hh:mm:ss)	6:28:46
Total ROV time (hh:mm:ss)	91:26:10

**Table 4.** Summary of scientific metrics for EX-21-07: Most of these metrics are also included as scientific metrics by dive in Table 6.

Scientific Metrics	Totals
Potential undescribed or novel species and new records observed*	2
Dives during which living corals and sponges were observed	12
Dives during which chemosynthetic communities were observed	1
Dives during which active seeps/vents were observed	0
Dives during which diverse benthic communities were observed	13

Scientific Metrics	Totals
Total samples	140
Biological samples (primary)	45
Biological associate samples	34
Geological samples (primary)	4
Geological associate samples	0
eDNA water samples	57
Actively participating scientists, students, and resource managers	47

\* Organisms unknown to science or an extension of their known range of geolocation or depth

## 7.1 ROV Survey Results

Depth ranges explored during the 14 ROV surveys were between 475 and 3,650 m. During the 14 dives, the ROVs spent a total of 47:18 hours on the bottom and 11:23 hours conducting targeted water column exploration. See **Tables 5 and 6** for dive-specific information.

**Table 5.** Summary information for the 14 ROV dives conducted during EX-21-07

Dive #	Site Name	Date (yyyymmdd)	On Bottom Latitude (dd)	On Bottom Longitude (dd)	Max Depth (m)	Dive Duration (hh:mm:ss)	Bottom Time (hh:mm:ss)	Water Column Exploration Time (hh:mm:ss)
01	Reef Tracts	20211027	31.20931	-77.85372	867	7:49:23	6:10:16	0:00:00
02	Bloody Marsh	20211029	MH*	MH*	475	8:07:19	6:09:47	0:00:00
03	Midwater North	20211101	30.70172	-77.38862	1016	8:20:05	1:11:02	4:18:16
04	Deep Mound	20211102	30.80283	-77.30079	1412	2:26:41	0:00:00	0:00:00
05	Deep Mound 2	20211102	30.80375	-77.30665	1413	5:00:25	3:16:44	0:00:00
06	Blake Spur Wall	20211103	30.19140	-76.16497	3650	7:52:06	3:05:20	0:00:00
07	Blake Spur Canyon	20211104	30.22188	-76.22128	3335	8:09:59	1:07:07	0:00:00
08	Sinkhole	20211105	28.91545	-77.02046	1203	4:45:07	2:58:28	0:00:00
09	Tortugas Scarp	20211108	24.16115	-83.05027	982	6:43:44	4:27:29	0:00:00
10	Shark Fin	20211109	24.38029	-84.10644	2456	8:07:14	4:55:41	0:00:00

Dive #	Site Name	Date (yyyymmdd)	On Bottom Latitude (dd)	On Bottom Longitude (dd)	Max Depth (m)	Dive Duration (hh:mm:ss)	Bottom Time (hh:mm:ss)	Water Column Exploration Time (hh:mm:ss)
11	Key West Scarp	20211110	23.93864	-82.05589	1151	7:59:49	5:38:13	0:00:00
12	Knolls North	20211112	29.73410	-78.42424	815	3:45:01	2:18:24	0:00:00
13	Midwater South	20211113	28.37477	-77.45858	500	4:05:39	0:00:00	2:10:30
14	Million Mounds South	20211114	28.53498	-79.26556	824	8:13:38	5:52:37	0:00:00

\*The locations of maritime heritage (MH) sites are restricted and protected under the National Historic Preservation Act. See Section 5.1 for more information.

**Table 6.** Summary of scientific metrics for the 14 ROV dives conducted during EX-21-07: Potential undescribed or novel species and new records observed, dives during which living corals and sponges were observed, dives during which chemosynthetic communities were observed, NO active seeps/vents were observed, dives during which diverse benthic communities were observed, and samples collected.

Dive #	Site Name	Undescribed Species	Corals & Sponges	Chemo-synthetic Community	Diverse Community	Water	Primary Biological Samples	Associate Biological Samples	Primary Geological Samples
01	Reef Tracts	No	Yes	No	Yes	5	8	6	-
02	Bloody Marsh	No	Yes	Yes	Yes	4	7	-	-
03	Midwater North	No	Yes	No	No	1	-	-	-
04	Deep Mound	-	-	-	-	5	4	6	1
05	Deep Mound 2	No	Yes	No	Yes	5	3	-	-
06	Blake Spur Wall	No	Yes	No	Yes	5	-	-	-
07	Blake Spur Canyon	No	Yes	No	Yes	5	3	3	2
08	Sinkhole	No	Yes	No	No	5	2	-	-
09	Tortugas Scarp	No	Yes	No	No	5	4	4	1
10	Shark Fin	No	Yes	No	Yes	5	9	7	-
11	Key West Scarp	No	Yes	No	Yes	5	1	-	-
12	Knolls North	No	Yes	No	No	2	-	-	-

Dive #	Site Name	Undescribed Species	Corals & Sponges	Chemo-synthetic Community	Diverse Community	Water	Primary Biological Samples	Associate Biological Samples	Primary Geological Samples
13	Midwater South	No	No	No	No	5	4	8	-
14	Million Mounds South	No	Yes	No	Yes	5	8	6	-

## 7.1.1 Accessing ROV Data

### NOAA Ocean Exploration Digital Atlas

ROV data from EX-21-07 are archived at the NOAA National Centers for Environmental Information (NCEI) and available through [NOAA Ocean Exploration’s Digital Atlas](#). To access these data, click on the Search tab, enter “EX2107” in the Enter Search Text field, and click Search. Click on the point that represents EX-21-07 to access data options. In the pop-up window, select the ROV Data Access tab for links to the ROV dive data, which is organized by dive.

### NCEI Dataset

The [EX-21-07 NCEI dataset](#) is an alternate resource for the ship and ROV data collected during the expedition. This dataset contains data collected from shipboard sensors, including navigational data, meteorological data (wind), and oceanographic data (bathythermograph, sound velocity probe, thermosalinograph). Additional data include profile data (ASVP, CTD, and XBT), event logs, images, ROV ancillary data, and sample data.

### ROV Dive Summaries

Individual ROV dive summaries and associated ROV dive data are archived at NCEI and available on the EX-21-07 pages of the [Okeanos Explorer ROV Expeditions website](#).

### ROV Dive Video

Video from dives conducted during expeditions on *Okeanos Explorer* is available in the [NOAA Ocean Exploration Video Portal](#), where it can be searched, previewed, and downloaded.

### SeaTube

NOAA Ocean Exploration works closely with Ocean Networks Canada to implement [SeaTube](#), a web-based annotation interface for ROV operations on expeditions on *Okeanos Explorer*.

SeaTube is the digital equivalent to a scientist's logbook. It’s used by onboard and shore-based scientists to log real-time observations on a variety of topics. To watch a video of a dive and search and export annotations, click on the “Expeditions” tree and select “NOAA,” “2021,” and “NOAA OER EX2107 (Oct 2021)”. To play an individual dive, click the play icon (triangle in a circle) to the left of the dive number and name. To search, select the expedition or individual dive and click the search icon (magnifying glass) to the left of the dive number and name.

## 7.2 Sampling Operations Results

A total of 140 samples were collected during EX-21-07: this includes 57 water samples for eDNA, 4 geological samples, 45 biological samples, and 34 associate samples (see **Table 6**)

The geological samples included 1 sample from a sinkhole, 2 samples from the Deep Mound site, and 1 sample from the Shark Fin site. See **Appendix C, Table C1** for full details of the geological samples collected.

There were 45 biological samples that were purposely collected (primary samples) as well as 34 samples that were incidentally collected (associate samples). In total, these samples amounted to 79 individuals. The biological samples included 7 annelids, 26 cnidarians, 5 ctenophores, 9 echinoderms, 20 sponges and 12 arthropods. See **Appendix C, Table C2** for full details of the biological samples collected.

Typically, five water samples were collected on every dive. There were exceptions due to operational challenges. Also, no samples were collected during the maritime heritage dive (Dive 02). See **Appendix C, Table C3** for full details of the water samples collected.

### 7.2.1 Sample Repositories

The following repositories archive samples collected during NOAA Ocean Exploration expeditions on *Okeanos Explorer*.

#### Biological Samples

##### [Invertebrate Zoology Collections](#)

National Museum of Natural History  
Smithsonian Institution, Museum Support Center  
MRC 534, 4210 Silver Hill Road, Suitland, MD 20746

#### DNA Samples

##### [Biorepository](#)

National Museum of Natural History  
Smithsonian Institution, Museum Support Center  
4210 Silver Hill Road, Suitland, MD 20746

#### Geological Samples

##### [Marine and Geology Repository](#)

Oregon State University  
Burt 346, Corvallis, OR 97331-5503

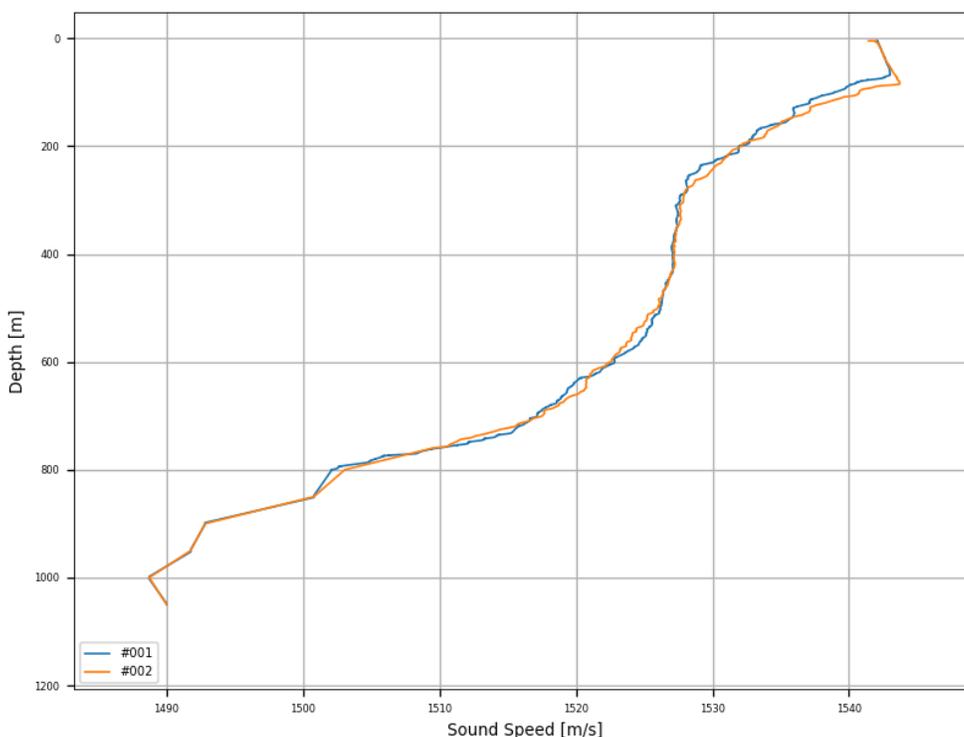
## 7.3 Acoustic Operations Results

During EX-21-07, multibeam mapping operations results included 2,001 linear km mapped and 15,800 square km covered (13,600 of these in U.S. waters deeper than 200 m). **Figure 1** shows the area covered by multibeam sonar bathymetry mapping. Also during the expedition, there were 127 XBT casts.

Most of the expedition's available mapping time was during overnight transits between widely spaced ROV dive locations. However, dive cancellations due to unfavorable conditions provided time to complete some larger surveys to fill gaps in existing multibeam sonar data coverage. Apart from a very small remaining gap, this expedition was successful at filling the small remaining gaps left in multibeam coverage over the Blake Plateau. The vast majority of multibeam coverage on the Blake Plateau was completed by NOAA Ocean Exploration using *Okeanos Explorer* over a series of missions beginning in 2014.

### 7.3.1 Multibeam Patch Test

Just prior to the start of this expedition, the ship had completed a drydock repair period. Since this was the first expedition following the drydock, a multibeam calibration patch test was deemed necessary to account for any significant changes in the multibeam sonar angular offset values. A CTD cast was conducted by the senior survey technician and the results were applied to the multibeam system. An XBT cast was also conducted. The two datasets agreed closely, confirming good measurements by both systems as well as a stable sound speed environment for the multibeam patch test calibration (see **Figure 2**).



**Figure 2.** Plot of CTD cast derived sound speed profile (blue) versus XBT-derived sound speed profile (yellow).

A multibeam patch test was completed the evening of October 27 in the vicinity of the first ROV dive. Very minor possible adjustments to angular offsets were calculated as a result:  $-0.03$  for pitch,  $-0.05$  for heading, and  $-0.04$  for roll. The offshore mapping team decided to hold off on applying these very minor changes until a deepwater patch test could be done later in the expedition near the Blake Spur to provide more confidence in the results. However, rough sea conditions made the deepwater patch test infeasible. Therefore, the initial patch test results were not applied to the data collected during the expedition.

Additional information about the mapping conducted during EX-21-07, including data quality assessments, is in the EX-21-07 mapping data report (Sowers et al., 2022).

### 7.3.2 Acoustic Operations Data Access

#### Multibeam Sonar (Kongsberg EM 304)

The multibeam dataset for the expedition is archived at NCEI and accessible through their [Bathymetric Data Viewer](#). To access these data, click on the Search Bathymetric Surveys button, select “NOAA Ship Okeanos Explorer” from the Platform Name dropdown menu, and “EX2107”

from the Survey ID dropdown menu. Click OK, and the ship track will appear on the map. Click the ship track for options to download data.

### Sub-Bottom Profiler (Knudsen Chirp 3260)

The sub-bottom profiler was not operated during any of EX-21-07's ROV dive operations, but generally was operated during multibeam mapping operations. These data are archived at NCEI and accessible through the [Trackline Geophysical Data Viewer](#). To access these data, select "Subbottom Profile" under Marine Surveys and click on Search Marine Surveys. In the pop-up window, select "EX2107" in the Filter by Survey IDs dropdown menu. Click OK, and the ship track will appear on the map. Click the ship track for options to download data.

### Split-Beam Sonars (Simrad EK60 and EK80)

EK60 and EK80 water column data for EX-21-07 are archived at NCEI and available through the [Water Column Sonar Data Viewer](#). To access these data, click on the Additional Filters button, deselect "All" next to Survey ID, and select "EX2107" from the Survey ID list. Click OK, and the ship track will appear on the map. Click on the ship track for options to download data.

### Acoustic Doppler Current Profilers (Teledyne Marine Workhorse Mariner and Teledyne Ocean Surveyor ADCPs)

ADCP data collected at each ROV dive location are archived at NCEI and available through the [Global Ocean Currents Database](#). Access these data by searching the table for the Expedition identifier "EX2107."

## 7.4 Conductivity, Temperature, and Depth Measurements

CTD profile data from EX-21-07 are archived at NCEI and available through [NOAA Ocean Exploration's Digital Atlas](#). To access these data, click on the Search tab, enter "EX2107" in the Enter Search Text field, and click Search. Click on the point that represents EX-21-07 to access data options. In the pop-up window, select the Data Access tab for a link to download the CTD profile data.

ROV CTD data from EX-21-07 can be found on the [NCEI's Okeanos Explorer website](#).

## 7.5 Sun Photometer Measurements

Sun photometer measurements from EX-21-07 are available through [NASA's Marine Aerosol Network](#). Access these data by searching the table for "2021," "Okeanos Explorer," and "North Atlantic Ocean." Click on the links to download the data. (Note: There may be more than one entry for *Okeanos Explorer* in a region in a given year.)

## 7.6 Engagement

EX-21-07 engaged with audiences around the world, opening a window of understanding into the deep ocean. Highlights are listed below:

- Engaged more than 127 scientists, resource managers, and students from around the world (47 actively), including 22 U.S. states, Canada, Mexico, Colombia, Portugal, Italy, the United Kingdom, Malta, Australia, Russia, and Japan.
- Engaged with audiences around the world, giving viewers a new understanding into the deep ocean through live interactions, live-streamed video, expedition web content, and media/web stories, including:
  - Two live interactions, including an interaction sponsored by the White House Office of Science and Technology Policy and the Smithsonian National Museum of Natural History that featured the president's science advisor and director of the White House Office of Science and Technology Policy, the director of the Smithsonian National Museum of Natural History, and the NOAA administrator. Expedition participants included Science Lead Allen Collins, Mapping Lead Derek Sowers, and Cmdr. Nicole Manning. This virtual interaction had approximately 1,600 views.
  - More than 66 news/web stories sharing expedition news, including a story about *SS Bloody Marsh*, which received the most coverage. Outlets included the 28 McClatchy papers (e.g., Miami Herald), AccuWeather, Newsweek, Live Science, The Weather Channel, and Fox News Weather.
  - More than 71,000 live video feed views during the expedition.
  - More than 16,000 expedition-specific web content views during the expedition.

## 8. Summary

Windows to the Deep 2021 was a 21-day telepresence-enabled expedition to collect essential information and acquire data on priority exploration areas identified by the ocean management and scientific communities. This expedition entailed exploration of a diversity of features along the Southeast U.S. continental margin with mapping and ROV operations. It targeted areas with the potential to host deep-sea coral and sponge communities and bioherms, maritime heritage sites, and deep-sea escarpments and also included water column exploration. Mapping data collected during this expedition improved previous mapping data and filled major data gaps in the region. During this expedition, NOAA Ocean Exploration also accomplished a milestone of 2 million square km mapped using *Okeanos Explorer*. Major accomplishments of this expedition are summarized below.

## Achieving ASPIRE Goals

Each ASPIRE expedition has its own objectives that support the goals of the larger campaign. Some of these goals are highlighted here with relevant accomplishments from Windows to the Deep 2021.

### **Goal: Improve knowledge of unexplored areas within the U.S. Exclusive Economic Zone (EEZ) and in deep-sea areas that have been mapped for the U.S. Extended Continental Shelf Project to inform management needs for sensitive habitats, geological features, maritime heritage sites, and potential resources.**

- Conducted 14 ROV dives ranging in depth from 475 to 3,650 m. Data collected can be used to increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.
- Collected 79 biological samples (45 primary and 34 associates), 4 geological samples, and 57 water samples.
  - Biological samples generally represented new records, potential new species, or dominant fauna.
  - Geological samples will be used to better understand the geological history of this region as well as to characterize habitat substrate.
  - Water samples were collected for environmental DNA (eDNA) processing using ROV *Deep Discoverer* as part of an operational pilot. Samples were collected at standardized waypoints on every dive.
- Completed additional ROV exploration of the largest nearly continuous deep-sea coral mound ecosystem discovered to date. The ROV dives added substantial evidence to the theory that the numerous mounds on the Stetson Mesa offshore of Florida and Georgia are due to the slow accumulation of *Lophelia pertusa* skeletal material over hundreds of thousands of years. This expedition explored three mounds. One was *L. pertusa* rubble, and two were rich with live coral stands at their crests.
- Conducted three ROV dives as well as mapping operations in the Stetson-Miami Terrace Deepwater Coral Habitat Area of Particular Concern (HAPC), which is managed by the South Atlantic Fishery Management Council (SAFMC). Two of the dives revealed high-density/high-diversity coral communities. The third dive targeted a shipwreck that may be a source of oil pollution.
- Discovered a high diversity of deep-sea corals and sponges on the Blake Spur wall and in the Blake Spur canyon (depths to 3,769 m) along the Blake Escarpment in previously unexplored areas.
- Discovered and explored what is likely the wreck of [SS Bloody Marsh](#) to support the U.S. Coast Guard and NOAA maritime heritage programs.

### **Goal: Locate and characterize deep-sea coral, sponge, and chemosynthetic communities.**

- Documented nine dive sites with high biological diversity.
- Documented deep-sea corals and sponges on every benthic dive.
- Documented new records, both collected and observed:
  - Potential new species collected included two species of sea pen.
  - Potential depth range extensions included:
    - *Paragorgia* sp. (bubblegum coral) seen below 3,000 m.
    - *Bythites gerdæ* seen 200 m or more below its known depth range and only seen *in situ* once or twice before.
  - Potential geographic range extensions included several fish:
    - *Deania calcea* (birdbeak dogfish)
    - *Gaidropsarus ensis* (boreal slope fish)
    - *Holcomycteronus* sp. (first *in situ* footage of this rarely observed genus)
- Documented the presence of commercially important species, including *Chaceon quinquedens* (red crab).
- Collected a *Habrocidaris* sp., a rare and unusual echinoid urchin, which will be used to assess its “ancient” looking morphology to determine if it represents an early diverging lineage or a more recent lineage that has converged on its ancient look.
- Collected a striking, blue encrusting hymedesmiid (order Poecilosclerida) demosponge with large oscules with thin membranes. The pigment proved to be ethanol soluble and stable and is therefore of biochemical importance.
- Documented a rare sighting of a large (approximately 5 m) [Magnapinna sp. \(bigfin squid\)](#), which has only been recorded about a dozen times in the literature.
- Documented a [homolodromiid crab carrying a sponge](#) over its body using its back legs.
- Documented several rarely observed predation events, including:
  - A *Gilbertaster caribæa* (sea star) feeding on a small, delicate coral (possibly a primnoid).
  - A *Circeaster americanus* (sea star) with forked hooks on the tips of its five arms feeding on a small coral (possibly a primnoid or paramuricid).
  - A pycnogonid (sea spider) from the family Colossendeidae feeding on an anemone.
  - A seven-armed solasterid (sun star) feeding on a pterasterid (slime star).

**Goal: Characterize water column habitats using acoustics, visual observations, and emerging technologies.**

- Conducted midwater exploration at depths ranging from 300 to 1,005 m during two dives to investigate the diversity and abundance of the midwater's largely unknown pelagic fauna.
- Documented several possibly new species of ctenophore during midwater transects. Two were collected from the waters just above the seafloor. This habitat is extremely difficult to sample with nets, so observations and collection of pelagic animals associated with deep-sea bottom environments are critical for complete documentation of marine biodiversity, especially when combined with sample collection.
- Collected water samples for eDNA processing at the start of every transect during water column dives and during ROV descent through the deep scattering layer during benthic-focused dives.

**Goal: Extend bathymetric mapping coverage in the U.S. Exclusive Economic Zone (EEZ) and international waters in support of Seabed 2030.**

- Mapped 15,800 square km of seafloor, an area larger than the state of Connecticut.
- Completed mapping of almost all the remaining small gaps in the multibeam sonar bathymetry of the Blake Plateau deeper than 250 m. NOAA Ocean Exploration has completed the vast majority of multibeam mapping on the plateau through a focused multiyear effort on *Okeanos Explorer*.
- Mapped gaps in multibeam sonar coverage in the Florida Straits during strategic ship transits.
- Mapped approximately 150-200 new deep-sea coral mounds, including dense mound aggregations at the western edge of the Blake Plateau within the Stetson-Miami Terrace Deepwater Coral HAPC.
- Improved bathymetric coverage and resolution on and around the international waters of the Blake Spur.

**Goal: Enhance predictive capabilities for vulnerable marine habitats and submarine geohazards.**

- Discovered numerous areas of deep-sea coral and sponge habitat, which has improved our understanding of this region and has habitat modeling implications that may apply to many other places throughout the ocean.

**Goal: Increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.**

- Collected two specimens to support trans-Atlantic connectivity studies: *Lophelia pertusa* and *Paramuricia* sp., the latter with an *Asteroschema* sp. (ophiuroid) associate.
- Collected multiple water samples for eDNA processing at standardized waypoints during all dives. Also collected a water sample of a single ASPIRE target species of interest from each dive.

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# Appendix A: EX-21-07 Shore-Based Science Team Members

**Table A1.** EX-21-07 shore-based science team members

First	Last	Email	Affiliation
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George	Matsumoto	mage@mbari.org	Monterey Bay Aquarium Research Institute
Megan	McCuller	megan.mcculler@naturalsciences.org	North Carolina Museum of Natural Sciences
Tina	Molodtsova	<a href="mailto:tina@ocean.ru">tina@ocean.ru</a>	Shirshov Institute of Oceanology
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Andrea	Quattrini	quattrinia@si.edu	Smithsonian National Museum of Natural History
Kevin	Rademacher	kevin.r.rademacher@noaa.gov	NOAA National Marine Fisheries Service Retired
John	Reed	jreed12@fau.edu	Florida Atlantic University- Harbor Branch Oceanographic Institute
Steve	Ross	rosss@uncw.edu	University of North Carolina Wilmington
Carolyn	Ruppel	cruppel@usgs.gov	United States Geological Survey
Robert	Schwemmer	Robert.Schwemmer@noaa.gov	NOAA National Marine Sanctuaries
Adam	Skarke	adam.skarke@msstate.edu	Mississippi State University
William	Sossorossi	william.sossorossi@noaa.gov	NOAA Monitor National Marine Sanctuary
Kenneth	Sulak	jumpingsturgeon@yahoo.com	United States Geological Survey
Timothy	Swain	tswain@nova.edu	Nova Southeastern University
Cindy	Van Dover	clv3@duke.edu	Duke University
Michael	Vecchione	vecchiom@si.edu	NOAA National Marine Fisheries Service & Smithsonian National Museum of Natural History
Kelsey	Viator	ksviator2000@gmail.com	University of Louisiana at Lafayette
Dani	Weissman	danielle.weissman@noaa.gov	NOAA Fisheries
Mary	Wicksten	Wicksten@bio.tamu.edu	Texas A&M University

# Appendix B: EX-21-07 Permits and Clearances

**Figure B1.** Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Permit for EX-21-07 (three pages)

<p>FORM 3-201A (1/97)</p>  <p><b>CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA</b></p>		<input type="checkbox"/> EXPORT PERMIT <input type="checkbox"/> RE-EXPORT CERTIFICATE <input checked="" type="checkbox"/> OTHER CERTIFICATE (see block 9)	Page 1 of 3 1. Original Permit/Certificate No. <b>21US13361E/9</b> 2. Valid until <b>2022-10-14</b>						
3. Permittee (name and address, country) NOAA OFFICE OF EXPLORATION AND RESEARCH (OER) 10008 BRUNETT AVE SILVER SPRING, MARYLAND 20901 U.S.A.		4. Consignee (name and address, country) INTRODUCTION FROM THE SEA							
5. Special Conditions ALL APPLICABLE FOREIGN, LOCAL, STATE, OR OTHER FEDERAL LAWS, INCLUDING THOSE REQUIRING PERMITS, MUST BE OBSERVED.  PERMIT MAY BE COPIED FOR MULTIPLE SHIPMENTS. PERMITTEE TO RETAIN ORIGINAL.  PERMITTEE MUST COMPLETE BLOCK(S) 11 (QUANTITY) PRIOR TO EACH SHIPMENT.  CONDITIONS CONTINUE ON PAGE 2 AND 3.		5a. Purpose of Transaction S  6. U.S. Management Authority Department of the Interior U.S. FISH AND WILDLIFE SERVICE DIVISION OF MANAGEMENT AUTHORITY BRANCH OF PERMITS, MS: IA 5275 LEESBURG PIKE FALLS CHURCH VA 22041-3803   <b>2021-10-15</b> Issuing Date United States Management Authority AUTHORITY: Endangered Species Act of 1973 (16 USC 1531 et. seq.)							
<i>For live animals, only valid if the transport conditions comply with the CITES Guidelines for Transport of Live Animals or, in the case of air transport, with IATA Live Animals Regulations.</i>									
7/8. Common Name and Scientific name (genus and species) of Animal or Plant  <b>A.</b> Common Name BLACK CORAL  Scientific Name ANTIPATHARIA		9. Description of Part or Derivative, including identifying marks or numbers (age/sex if live) 9. INTRODUCTION FROM THE SEA: FRAGMENT OR BRANCH OF CORAL.							
12. Country of Origin HIGH SEAS		Permit/Certificate No.	Date of Issue						
12a. Country of Last Re-export		Re-export Certificate No.	Date of Issue						
<b>B.</b> Common Name STONY CORAL  Scientific Name SCLERACTINIA		9. INTRODUCTION FROM THE SEA: FRAGMENT OR BRANCH OF CORAL.							
12. Country of Origin HIGH SEAS		Permit/Certificate No.	Date of Issue						
12a. Country of Last Re-export		Re-export Certificate No.	Date of Issue						
13. Export / Re-export Endorsement: The official who inspects shipment upon exportation / re-exportation must enter the total quantities of specimens being exported / re-exported in this block.		14. Bill of Lading/Air Way-Bill Number  Port of Exportation / Re-exportation  Total No. of Shipping Containers							
<table border="1"> <thead> <tr> <th>See Block 7</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td>A</td> <td></td> </tr> <tr> <td>B</td> <td></td> </tr> </tbody> </table>		See Block 7	Quantity	A		B		10. Appendix No. and Source 10. 2 X  11. Quantity (including units) NO  11a. Total Exported/Quota	
See Block 7	Quantity								
A									
B									
12b. Breeding Operation No.		12c. Pre-Convention: Date of Acquisition							
15. This document valid only with inspecting official's ORIGINAL stamp, signature and date in this block.									
Inspecting Official's Stamp, Signature and Date									



SPECIAL PERMIT  
CONDITIONS

Department of the Interior  
U.S. Fish and Wildlife Service  
Division of Management Authority  
Falls Church, VA 22041  
UNITED STATES OF AMERICA

Page 2 of 3

1. Original Permit/Certificate No.

21US13361E/9

5/6. THIS PERMIT IS ISSUED UNDER AUTHORITY OF THE ENDANGERED SPECIES ACT

(if seq.) BY:

Falls Church, VA  
Place

2021-10-15  
Issuing Date

U.S. Fish and Wildlife Service  
Management Authority  
United States Department of the Interior

PERMITTEE: NOAA OFFICE OF EXPLORATION AND RESEARCH (OER)

**Block 5: Special Permit Conditions**

1. Samples collected from wild-caught animals: Samples collected from wild-caught animals may be brought into the United States under this Introduction from the Sea (IFS) certificate provided the conditions of 2 through 4 and 6 through 8 are met.
2. No remuneration, either financial or in-kind, may be offered for the taking of animals from the wild (i.e., killing, trapping) or for the collection of samples from free-ranging wildlife. This condition does not preclude legitimate collection and transportation expenses (e.g., hiring staff, freight costs), but does prohibit the paying of bounties or incentive pay for taking of animals from the wild, or the collection of samples from animals in the wild. Explicit written approval for collection from wild animals must be obtained from appropriate wildlife authorities and retained in the applicant's files for a period of at least 5 years, or as long as you possess the specimens as stated in 50 CFR 23.34(c) and must be supplied upon the Division of Scientific Authority's request.
3. No animals may be killed intentionally for the purpose of collecting samples.
4. Care must be taken when handling live animals to minimize any possibility of injury. If, for any reason, any wild or captive-held animal dies or incurs a debilitating injury as a result of being restrained for sample collection, or while having the sample collected, further collection of samples must be suspended until methods are evaluated and, if appropriate, modified to prevent further incidences of injury or death. If two or more animals die or incur debilitating injuries within a 6-month period, sample collection must be suspended and the Division of Scientific Authority contacted in writing within 7 days of the death of the second individual. Before further sampling will be authorized a written account of the details of the event, and recommendations to resolve the situation, must be submitted for a review of sampling procedures (point of contact: Dr. Rosemarie Gnam, Chief, Division of Scientific Authority, MS: IA, 5275 Leesburg Pike, Falls Church, VA 22041-3803; tel. 703-358-1708; fax 703-358-2276).
5. In the event that samples are collected from salvage: Samples collected from salvaged dead wild animals may be imported provided: (a) the collection of the samples occurs in a manner that does not disrupt other animals' movements or behavior during a critical phase of their activities or life cycle, and (b) provided the conditions below are met. Salvage is defined as the collection of samples from dead animals that were not killed intentionally or that died of causes unrelated either to the collection of samples or the capture of the animal for the purpose of obtaining samples.

15. EXPORT/RE-EXPORT/IMPORT ENDORSEMENT: I, the inspecting official, certify that the information provided above is accurate. This document is valid only with inspecting official's ORIGINAL stamp, signature and date in this block.

Inspecting Official's Stamp, Signature and Date



SPECIAL PERMIT  
CONDITIONS

Department of the Interior  
U.S. Fish and Wildlife Service  
Division of Management Authority  
Falls Church, VA 22041  
UNITED STATES OF AMERICA

Page 3 of 3

1. Original Permit/Certificate No.

21US13361E/9

5/6. THIS PERMIT IS ISSUED UNDER AUTHORITY OF THE ENDANGERED SPECIES

Act (16 U.S.C. 1531 et seq.) BY:

Falls Church, VA  
Place

2021-10-15  
Issuing Date



PERMITTEE: NOAA OFFICE OF EXPLORATION AND RESEARCH (OER)

**BLOCK 5: Special Permit Conditions**

- 6. The applicant must maintain a record of all of specimens/samples under this IFS certificate that must be made available to the USFWS Division of Scientific Authority upon request. This record should include for each IFS shipment: the species and type(s) of specimens/samples, date(s) collected, the date shipped, the location(s) of collection and name of person who collected the sample(s), conditions under which samples were collected (salvage, captive-held, or wild-caught), authorizing government agency, and any mortalities or debilitating injuries that may have occurred as a result, directly or indirectly, of the collection activities.
- 7. The applicant must maintain copies of all CITES IFS certificates used to obtain the requested specimens, which must be made available to the USFWS Division of Scientific Authority upon request.

15. EXPORT/RE-EXPORT/IMPORT ENDORSEMENT: I, the inspecting official, certify that the information provided above is accurate. This document is valid only with inspecting official's ORIGINAL stamp, signature and date in this block.

Inspecting Official's Stamp, Signature and Date

Figure B2. Designated Port Exception Permit

Page 1 of 1

DESIGNATED PORT EXCEPTION PERMIT  
SCIENTIFIC PURPOSES

**Permit Number: D80153**  
Date Effective: 10/15/2021      Date Expires: 07/12/2023



Issuing Office:  
Department of the Interior  
U.S. FISH AND WILDLIFE SERVICE  
Office of Law Enforcement  
1875 Century Boulevard, Suite 380  
Atlanta, GA 30345  
Tel: 404-679-7195  
Email: permitsEastLE@fws.gov

**DARLENE SARPONG**

Digitally signed by DARLENE SARPONG  
Date: 2021.10.15 16:03:47 -04'00'

*Legal Instruments Examiner*

Permittee:  
**NOAA OCEAN EXPLORATION**  
1315 EAST-WEST HWY., SSMC3 ROM 10229  
SILVER SPRING, MARYLAND 20910  
US

Name and Title of Principal Officer  
KASEY NMN CANTWELL - OPERATIONS CHIEF

---

Authority: Statutes and Regulations: 16 USC 1538 (f); 50 CFR SUBPART 13, 50 CFR 14.

**Location where authorized activity may be conducted:**  
PORT CANAVERAL, FL    NEWPORT, RI

**Reporting requirements:**  
PERMITEE IS REQUIRED TO MAINTAIN RECORDS PER 50 CFR 13.  
ACCEPTANCE OF THIS PERMIT AUTHORIZES INSPECTION PER 50 CFR 13.

**Authorizations and Conditions:**

- A. General conditions set out in Subpart D of 50 CFR 13, and specific conditions contained in Federal regulations cited above, are hereby made a part of this permit. All activities authorized herein must be carried out in accord with and for the purposes described in the application submitted. Continued validity, or renewal of this permit is subject to complete and timely compliance with all applicable conditions, including the filing of all required information and reports.
- B. The validity of this permit is also conditioned upon strict observance of all applicable foreign, state, local tribal, or other federal law.
- C. Valid for use by permittee named above.
- D. Permittee is responsible for requesting renewal of permit at least 30 days prior to the expiration date as outlined in 50 CFR 13. Service Law Enforcement Officers will not clear shipments presented for import or export under expired permits.
- E. Permittee is authorized to import/export wildlife and/or wildlife products at the port(s) specified above.
- F. Permittee must also comply with inspection and clearance procedures as outlined in 50 CFR 14, upon importation/exportation of wildlife and/or wildlife products.
- G. Permittee must comply with additional permit conditions as set forth in 50 CFR 14.31.
- H. Permittee must contact U.S. Fish & Wildlife Service, Wildlife Inspectors at least 72 hours prior to the proposed import/export at the Tampa Inspection Office/Wildlife Inspector Matthew Belue at 407-244-2318 or 813-348-1500 for clearance of Port Canaveral shipment. Permittee must contact Wildlife Inspectors at the Chelsea, MA office at (617) 889-6616 at least 72 hours prior to the proposed import/export at the following location(s): Newport, RI. Permittee is responsible for all associated inspection costs to include, but not limited to: Inspection and overtime fees, travel, transportation and per diem costs.

## Appendix C: Inventories of Geological, Biological, and eDNA Water Samples

**Table C1.** Inventory of geological samples collected during EX-21-07

Dive #	Site Name	Sample #	Sample ID	Preservation	Collection Rationale	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Weight (kg)
05	Deep Mound 2	Rock	EX2107_DIVE 05_03G	Dried	Characteristic of site	20211102	184552	30.805100	-77.306660	1416.88	1.30
08	Sinkhole	Rock	EX2107_DIVE 08_06G	Dried	Characteristic of site	20211105	155026	28.916490	-77.021220	1193.15	0.53
08	Sinkhole	Rock	EX2107_DIVE 08_03G	Dried	Characteristic of site	20211105	151642	28.916860	-77.021160	1204.82	1.03
10	Shark Fin	Rock	EX2107_DIVE 10_06G	Dried	Characteristic of site	20211109	165648	24.380780	-84.110790	2412.70	1.16

**Table C2.** Inventory of biological samples collected during EX-21-07

Dive #	Site Name	Sample #	Name	Preservative	Collection Rationale	Date (YYYY mddd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
01	Reef Tracts	D01_03B	Primnoidea	95% EtOH	Associate	20211027	143400	31.21158	-77.8525	866.8	34.92	4.72	5.3
01	Reef Tracts	D01_03B_A01	Uroptychus	95% EtOH	Undescribed	20211027	143400	31.21158	-77.8525	866.8	34.92	4.72	5.3
01	Reef Tracts	D01_04B	Rhopalonematidae	5% Fo	Unidentified	20211027	144839	31.21145	-77.8525	861.3	34.95	4.73	5.29
01	Reef Tracts	D01_05B	Axinellidae	95% EtOH	Unidentified	20211027	160230	31.21059	-77.8524	844.8	35.11	6.79	5.07
01	Reef Tracts	D01_07B	Characella	95% EtOH	Undescribed	20211027	163152	31.21042	-77.8525	840.6	35.03	7.09	4.77
01	Reef Tracts	D01_08B	<i>Gilbertaster caribaea</i>	95% EtOH	Behavioral	20211027	170426	31.21017	-77.8526	831.6	35.18	7.4	4.29
01	Reef Tracts	D01_08B_A01	Cnidaria	95% EtOH	Associate	20211027	170426	31.21017	-77.8526	831.6	35.18	7.4	4.29
01	Reef Tracts	D01_08B_A02	Amphipoda	95% EtOH	Associate	20211027	170426	31.21017	-77.8526	831.6	35.18	7.4	4.29
01	Reef Tracts	D01_09B	<i>Chrysogorgia</i>	95% EtOH	Characteristic	20211027	173252	31.21009	-77.8528	821.5	35.14	7.55	4.52
01	Reef Tracts	D01_09B_A01	Galatheaidea	95% EtOH	Associate	20211027	173252	31.21009	-77.8528	821.5	35.14	7.55	4.52

Dive #	Site Name	Sample #	Name	Preservative	Collection Rationale	Date (yyyy mmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
01	Reef Tracts	D01_09B_A02	Penaeidae	95% EtOH	Associate	20211027	173252	31.21009	-77.8528	821.5	35.14	7.55	4.52
01	Reef Tracts	D01_10B	<i>Pseudodrifa</i>	95% EtOH	Characteristic	20211027	173819	31.21007	-77.8528	821.5	35.11	7.6	4.02
01	Reef Tracts	D01_10B_A01	Scleractinia	95% EtOH	Associate	20211027	173819	31.21007	-77.8528	821.5	35.11	7.6	4.02
01	Reef Tracts	D01_12B	<i>Oceanapia</i>	95% EtOH	Undescribed	20211027	193316	31.21067	-77.8546	814.8	35.15	8.14	4.16
03	Midwater North	D03_04B	<i>Lobata</i>	95% EtOH	Undescribed	20211101	153936	30.70515	-77.4054	602	36.27	16.69	5.77
03	Midwater North	D03_05B	Cydippida	Rain-x	Undescribed	20211101	161936	30.7062	-77.4104	702.5	35.92	14.59	5.36
03	Midwater North	D03_07B	Cydippida	Rain-x	Undescribed	20211101	180522	30.70856	-77.419	1008.1	35.04	5.37	7.38
03	Midwater North	D03_08B	Ctenoceros	Rain-x	Undescribed	20211101	181138	30.7085	-77.4191	1006.8	35.05	5.5	7.29
03	Midwater North	D03_09B	<i>Aegina</i>	5% Fo	Undescribed	20211101	181612	30.70857	-77.4191	1008	35.04	5.48	7.32
03	Midwater North	D03_10B	Pennatulacea	95% EtOH	Rare	20211101	190220	30.70858	-77.4191	1018.6	35.02	4.7	7.89
03	Midwater North	D03_11B	Anthoptilum	95% EtOH	Undescribed	20211101	192530	30.70847	-77.4191	1019	35.01	4.71	7.92
05	Deep Mound 2	D05_03G_A01	Porifera	95% EtOH	Associate	20211102	184552	30.8051	-77.3067	1416.9	34.99	4.2	8.23
05	Deep Mound 2	D05_03G_A02	Porifera	95% EtOH	Associate	20211102	184552	30.8051	-77.3067	1416.9	34.99	4.2	8.23
05	Deep Mound 2	D05_04B	Bolosominae	95% EtOH	Undescribed	20211102	192024	30.80504	-77.3068	1412.5	34.99	4.2	8.21
05	Deep Mound 2	D05_04B_A01	Paguroidea	95% EtOH	Associate	20211102	192024	30.80504	-77.3068	1412.5	34.99	4.2	8.21
05	Deep Mound 2	D05_04B_A02	Polychaeta	5% Fo	Associate	20211102	192024	30.80504	-77.3068	1412.5	34.99	4.2	8.21
05	Deep Mound 2	D05_04B_A03	Amphipoda	95% EtOH	Associate	20211102	192024	30.80504	-77.3068	1412.5	34.99	4.2	8.21
05	Deep Mound 2	D05_05B	<i>Calibelemnon</i>	95% EtOH	Undescribed	20211102	202043	30.80488	-77.3074	1393.6	34.99	4.2	8.22
05	Deep Mound 2	D05_06B	Paramuricea	95% EtOH	Associate	20211102	203007	30.80489	-77.3074	1390.9	34.99	4.2	8.19
05	Deep Mound 2	D05_06B_A01	<i>Asteroschema</i>	95% EtOH	Associate	20211102	203007	30.80489	-77.3074	1390.9	34.99	4.2	8.19
05	Deep Mound 2	D05_08B	<i>Mediaster</i>	95% EtOH	Undescribed	20211102	205026	30.80481	-77.3075	1385.7	34.99	4.2	8.21
06	Blake Spur Wall	D06_03B	<i>Tretopleura</i>	95% EtOH	Abundant	20211103	155253	30.19153	-76.1637	3651.3	34.9	2.34	8.13
06	Blake Spur Wall	D06_04B	<i>Amphidiscella</i>	95% EtOH	Undescribed	20211103	165333	30.1912	-76.1644	3626.4	34.9	2.37	8.24
06	Blake Spur Wall	D06_06B	Demospongiae	95% EtOH	Undescribed	20211103	170757	30.19115	-76.1645	3624.5	34.9	2.33	8.13
08	Sinkhole	D08_04B	Gastropoda	95% EtOH	Unidentified	20211105	152118	28.91684	-77.0212	1205.6	35	4.38	8.14

Dive #	Site Name	Sample #	Name	Preservative	Collection Rationale	Date (yyyy mmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
08	Sinkhole	D08_07B	Habrocidaris	95% EtOH	Undescribed	20211105	160552	28.91649	-77.0212	1192.5	35	4.39	8.16
08	Sinkhole	D08_08B	Cornulariidae	95% EtOH	Undescribed	20211105	170549	28.91616	-77.0212	1162.2	35.01	4.38	8.08
08	Sinkhole	D08_08B_A01	Isopoda	95% EtOH	Associate	20211105	170549	28.91616	-77.0212	1162.2	35.01	4.38	8.08
08	Sinkhole	D08_08B_A02	Thecata	95% EtOH	Associate	20211105	170549	28.91616	-77.0212	1162.2	35.01	4.38	8.08
08	Sinkhole	D08_08B_A03	Sabellidae	95% EtOH	Associate	20211105	170549	28.91616	-77.0212	1162.2	35.01	4.38	8.08
09	Tortugas Scarp	D09_03B	Polynoidae	5% Fo	Undescribed	20211108	171110	24.16158	-83.0509	985.7	34.89	5.8	5
09	Tortugas Scarp	D09_06B	Poecilosclerida	95% EtOH	Undescribed	20211108	202502	24.16265	-83.0531	923.7	34.9	5.84	4.96
10	Shark Fin	D10_03B	Keratoisididae	95% EtOH	Undescribed	20211109	161723	24.38071	-84.1109	2425.4	34.98	4.33	6.81
10	Shark Fin	D10_05B	Paramuricea	95% EtOH	Undescribed	20211109	164500	24.38071	-84.111	2416.6	35	4.32	6.81
10	Shark Fin	D10_07B	Farreidae	95% EtOH	Undescribed	20211109	171705	24.3807	-84.1108	2411	35	4.32	6.74
10	Shark Fin	D10_07B_A01	Keratoisis	95% EtOH	Associate	20211109	171705	24.3807	-84.1108	2411	35	4.32	6.74
10	Shark Fin	D10_07B_A02	Polychaeta	5% Fo	Associate	20211109	171705	24.3807	-84.1108	2411	35	4.32	6.74
10	Shark Fin	D10_07B_A03	Amphipoda	95% EtOH	Associate	20211109	171705	24.3807	-84.1108	2411	35	4.32	6.74
10	Shark Fin	D10_09B	Paramuricea	95% EtOH	Undescribed	20211109	190518	24.38065	-84.1094	2361.9	35	4.32	6.76
10	Shark Fin	D10_09B_A01	Astroschema	95% EtOH	Associate	20211109	190518	24.38065	-84.1094	2361.9	35	4.32	6.76
11	Key West Scarp	D11_03B	Farreidae	95% EtOH	Undescribed	20211110	161659	23.96971	-81.7999	1155	35.06	4.4	6.66
11	Key West Scarp	D11_03B_A01	Zoantharia	5% Fo	Associate	20211110	161659	23.96971	-81.7999	1155	35.06	4.4	6.66
11	Key West Scarp	D11_03B_A02	Polychaeta	5% Fo	Associate	20211110	161659	23.96971	-81.7999	1155	35.06	4.4	6.66
11	Key West Scarp	D11_03B_A03	Amphipoda	95% EtOH	Associate	20211110	161659	23.96971	-81.7999	1155	35.06	4.4	6.66
11	Key West Scarp	D11_04B	Chondrocladia	95% EtOH	Rare	20211110	171046	23.96979	-81.8001	1137.1	35.02	4.49	6.51
11	Key West Scarp	D11_06B	Farreidae	95% EtOH	Undescribed	20211110	175603	23.96988	-81.8001	1126.1	35.8	4.43	6.53
11	Key West Scarp	D11_06B_A01	Zoantharia	5% Fo	Associate	20211110	175603	23.96988	-81.8001	1126.1	35.8	4.43	6.53
11	Key West Scarp	D11_07B	Abyssocladia	95% EtOH	Undescribed	20211110	180003	23.96988	-81.8001	1126	35.81	4.44	6.53
11	Key West Scarp	D11_08B	Chrysogorgiidae	95% EtOH	Undescribed	20211110	181243	23.96987	-81.8001	1126	35.83	4.44	6.51
11	Key West Scarp	D11_09B	<i>Hyalonema</i>	95% EtOH	Undescribed	20211110	184302	23.96995	-81.8003	1116.7	35.87	4.46	6.49
11	Key West Scarp	D11_09B_A01	Zoantharia	5% Fo	Associate	20211110	184302	23.96995	-81.8003	1116.7	35.87	4.46	6.49
11	Key West Scarp	D11_09B_A02	Paguridae	95% EtOH	Associate	20211110	184302	23.96995	-81.8003	1116.7	35.87	4.46	6.49
11	Key West Scarp	D11_11B	<i>Chrysogorgia</i>	95% EtOH	Associate	20211110	191758	23.96997	-81.8002	1114.1	35.91	4.47	6.45
11	Key West Scarp	D11_12B	<i>Solenasmilla</i>	95% EtOH	Characteristic	20211110	194248	23.96998	-81.8002	1113.7	35.92	4.48	6.45

Dive #	Site Name	Sample #	Name	Preservative	Collection Rationale	Date (yyyy mmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
11	Key West Scarp	D11_13B	<i>Acanella aurelia</i>	95% EtOH	Rare	20211110	200653	23.97004	-81.8002	1113.9	35.93	4.47	6.46
11	Key West Scarp	D11_13B_A01	<i>Uroptychus</i>	95% EtOH	Associate	20211110	200653	23.97004	-81.8002	1113.9	35.93	4.47	6.46
12	Knolls North	D12_06B	<i>Lophelia pertusa</i>	95% EtOH	ASPIRE	20211112	205554	29.74479	-78.435	752.2	35.52	9.85	4.2
14	Million Mounds South	D14_03B	Ophiomyxidae	95% EtOH	Rare	20211114	155251	28.53926	-79.2629	821.5	35.13	7.18	5.68
14	Million Mounds South	D14_04B	<i>Abyssocladia</i>	95% EtOH	Rare	20211114	160243	28.53925	-79.263	821.5	35.12	7.05	5.81
14	Million Mounds South	D14_04B_A01	<i>Lophelia pertusa</i>	95% EtOH	Associate	20211114	160243	28.53925	-79.263	821.5	35.12	7.05	5.81
14	Million Mounds South	D14_04B_A02	<i>Cladorhiza</i>	95% EtOH	Associate	20211114	160243	28.53925	-79.263	821.5	35.12	7.05	5.81
14	Million Mounds South	D14_04B_A03	Ophiuroidea	95% EtOH	Associate	20211114	160243	28.53925	-79.263	821.5	35.12	7.05	5.81
14	Million Mounds South	D14_04B_A04	Polychaeta	95% EtOH	Associate	20211114	160243	28.53925	-79.263	821.5	35.12	7.05	5.81
14	Million Mounds South	D14_05B	Hexactinellida	95% EtOH	Undescribed	20211114	162447	28.539	-79.2628	820.7	35.1	6.99	5.91
14	Million Mounds South	D14_05B_A01	Polynoidae	5% Fo	Associate	20211114	162447	28.539	-79.2628	820.7	35.1	6.99	5.91
14	Million Mounds South	D14_07B	Rosellidae	95% EtOH	Undescribed	20211114	201640	28.53962	-79.2602	766.4	35.13	7.38	5.52
14	Million Mounds South	D14_07B_A01	Amphipoda	95% EtOH	Associate	20211114	201640	28.53962	-79.2602	766.4	35.13	7.38	5.52
14	Million Mounds South	D14_07B_A02	Ophiuroidea	95% EtOH	Associate	20211114	201640	28.53962	-79.2602	766.4	35.13	7.38	5.52
14	Million Mounds South	D14_07B_A03	Ophiuroidea	95% EtOH	Associate	20211114	201640	28.53962	-79.2602	766.4	35.13	7.38	5.52

\*Biological sample numbers with “\_A##” indicate associate samples

**Table C3.** Inventory of water samples collected for eDNA during EX-21-07

Dive #	Site Name	Sample #	Preservative	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
01	Reef Tracts	D01_01W	Longmire's	20211027	131133	31.21016	-77.8532	505.1	36.49	18.15	4.74
01	Reef Tracts	D01_02W	Longmire's	20211027	134939	31.21166	-77.8525	869.2	35.04	4.72	5.25
01	Reef Tracts	D01_06W	Longmire's	20211027	160654	31.21058	-77.8525	844.7	35.08	6.85	4.75
01	Reef Tracts	D01_11W	Longmire's	20211027	180449	31.21004	-77.853	809.2	35.12	7.67	4.74
01	Reef Tracts	D01_13W	Longmire's	20211027	195036	31.21083	-77.8549	802.7	35.17	8.85	4.39
03	Midwater North	D03_01W	Longmire's	20211101	132404	30.70145	-77.3893	301.8	36.68	19.13	6.8
03	Midwater North	D03_02W	Longmire's	20211101	142104	30.70288	-77.3955	501.5	36.58	18.46	6.43
03	Midwater North	D03_03W	Longmire's	20211101	151256	30.70441	-77.402	601.6	36.26	16.67	5.76
03	Midwater North	D03_06W	Longmire's	20211101	170131	30.70758	-77.4154	902.4	35.31	9.96	4.74
04	Deep Mound	D04_01W	Longmire's	20211102	130913	30.80556	-77.3029	1003.1	35.13	7.14	5.85
05	Deep Mound 2	D05_01W	Longmire's	20211102	174622	30.8047	-77.3067	508.5	36.56	18.34	6.37
05	Deep Mound 2	D05_02W	Longmire's	20211102	182427	30.80512	-77.3066	1416.7	34.99	4.2	8.19
05	Deep Mound 2	D05_07W	Longmire's	20211102	203447	30.8048	-77.3075	1386.7	34.99	4.2	8.18
05	Deep Mound 2	D05_09W	Longmire's	20211102	213046	30.80423	-77.3085	1355.1	34.99	4.2	8.21
05	Deep Mound 2	D05_10W	Longmire's	20211102	182500	30.80512	-77.3066	1416.7	34.99	4.2	8.19
06	Blake Spur Wall	D06_01W	Longmire's	20211103	131606	30.19438	-76.1621	506.6	36.31	16.89	5.79
06	Blake Spur Wall	D06_02W	Longmire's	20211103	153536	30.19141	-76.1636	3649.8	34.9	2.35	8.24
06	Blake Spur Wall	D06_05W	Longmire's	20211103	165637	30.19128	-76.1644	3625.8	34.9	2.36	8.17
06	Blake Spur Wall	D06_07W	Longmire's	20211103	182404	30.19049	-76.1651	3600.9	34.9	2.39	8.14
06	Blake Spur Wall	D06_08W	Longmire's	20211103	185554	30.18979	-76.1644	2800.9	34.92	2.76	8.23
07	Blake Spur Canyon	D07_01W	Longmire's	20211104	125421	30.22394	-76.2201	510.1	36.36	17.18	5.78
07	Blake Spur Canyon	D07_02W	Longmire's	20211104	175251	30.22308	-76.2255	3191	34.92	2.69	8.19
07	Blake Spur Canyon	D07_03W	Longmire's	20211104	182804	30.2227	-76.2256	3199.2	34.92	2.68	8.21
07	Blake Spur Canyon	D07_04W	Longmire's	20211104	184011	30.22282	-76.2253	3187.3	34.92	2.69	8.24
07	Blake Spur Canyon	D07_05W	Longmire's	20211104	190020	30.22292	-76.2248	2797.4	34.93	2.83	8.28
08	Sinkhole	D08_01W	Longmire's	20211105	142250	28.91623	-77.0213	508.8	35.6	12.44	4.4

Dive #	Site Name	Sample #	Preservative	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
08	Sinkhole	D08_02W	Longmire's	20211105	145520	28.91688	-77.0212	1205.3	35	4.39	8.14
08	Sinkhole	D08_05W	Longmire's	20211105	154313	28.91651	-77.0212	1192.9	35	4.39	8.12
08	Sinkhole	D08_09W	Longmire's	20211105	171511	28.91612	-77.0211	1154.2	35	4.38	8.11
08	Sinkhole	D08_10W	Longmire's	20211105	175105	28.91594	-77.0215	1090.5	35.01	4.54	8.03
09	Tortugas Scarp	D09_01W	Longmire's	20211108	153558	24.16361	-83.0528	503.3	35.08	9.04	3.87
09	Tortugas Scarp	D09_02W	Longmire's	20211108	162307	24.16137	-83.05	984.3	34.87	5.82	5
09	Tortugas Scarp	D09_04W	Longmire's	20211108	191442	24.16221	-83.0528	973.3	34.9	5.83	5
09	Tortugas Scarp	D09_05W	Longmire's	20211108	201816	24.16262	-83.0532	924.5	34.9	5.83	4.96
09	Tortugas Scarp	D09_07W	Longmire's	20211108	204557	24.16268	-83.0533	899.8	34.9	6.02	4.8
10	Shark Fin	D10_01W	Longmire's	20211109	135332	24.3799	-84.1123	504	35.02	8.31	3.91
10	Shark Fin	D10_02W	Longmire's	20211109	150619	24.38024	-84.1113	2461.4	34.95	4.33	6.83
10	Shark Fin	D10_04W	Longmire's	20211109	162948	24.38074	-84.111	2419.2	35	4.32	6.84
10	Shark Fin	D10_08W	Longmire's	20211109	184324	24.38044	-84.1096	2365	35	4.32	6.79
10	Shark Fin	D10_10W	Longmire's	20211109	201017	24.38067	-84.1087	2357.6	35	4.32	6.71
11	Key West Scarp	D11_01W	Longmire's	20211110	143135	23.9695	-81.7987	502.2	35.75	13.61	4.28
11	Key West Scarp	D11_02W	Longmire's	20211110	151140	23.96935	-81.7992	1152.2	35.08	4.4	6.64
11	Key West Scarp	D11_05W	Longmire's	20211110	172010	23.96983	-81.8001	1131	35.05	4.43	6.54
11	Key West Scarp	D11_10W	Longmire's	20211110	185447	23.96998	-81.8003	1115.2	35.89	4.46	6.48
11	Key West Scarp	D11_14W	Longmire's	20211110	203457	23.97042	-81.8002	1111.1	35.93	4.48	6.41
12	Knolls North	D12_01W	Longmire's	20211112	181420	29.74822	-78.4357	502.3	36.22	16.35	5.53
12	Knolls North	D12_02W	Longmire's	20211112	184755	29.74693	-78.4334	816.3	35.17	7.93	5.32
12	Knolls North	D12_03W	Longmire's	20211112	200011	29.74591	-78.4342	765	35.52	9.89	4.24
12	Knolls North	D12_04W	Longmire's	20211112	204221	29.74481	-78.4351	751.1	35.52	9.86	4.2
12	Knolls North	D12_05W	Longmire's	20211112	205250	29.7448	-78.435	752.3	35.52	9.85	4.21
13	Midwater South	D13_01W	Longmire's	20211113	143119	28.36701	-78.2522	301.3	36.61	19	5.57
13	Midwater South	D13_02W	Longmire's	20211113	155655	28.35974	-78.2463	501.8	36.1	15.53	5.34
14	Million Mounds South	D14_01W	Longmire's	20211114	140746	28.54256	-79.2651	501.9	36.12	15.63	5.41
14	Million Mounds South	D14_02W	Longmire's	20211114	150327	28.53944	-79.2634	825.3	35.12	6.72	6.16
14	Million Mounds South	D14_06W	Longmire's	20211114	174338	28.5385	-79.2621	774.1	35.13	7.9	5.01

Dive #	Site Name	Sample #	Preservative	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temp (°C)	Dissolved O <sub>2</sub> (mg/l)
14	Million Mounds South	D14_08W	Longmire's	20211114	201918	28.53965	-79.2602	765.7	35.14	7.94	4.96
14	Million Mounds South	D14_09W	Longmire's	20211114	204152	28.53967	-79.2597	760.4	35.14	8.23	4.65